

## PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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GOWLING LAFLEUR HENDERSON LLP  
PATENT DEPARTMENTNOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

Fax: +1 416 862 7661

- 13 pages -

Fax in advance

Date of mailing  
(day/month/year)

26.11.2004

Applicant's or agent's file reference  
T8467521WO

## IMPORTANT NOTIFICATION

International application No.  
PCT/CA 03/00960International filing date (day/month/year)  
25.06.2003Priority date (day/month/year)  
25.06.2002

Applicant

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

## 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international  
preliminary examining authority:

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**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**  
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>T8467521WO</b>	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. <b>PCT/CA 03/00860</b>	International filing date (day/month/year) <b>25.06.2003</b>	Priority date (day/month/year) <b>25.06.2002</b>
International Patent Classification (IPC) or both national classification and IPC <b>C01B3/00</b>		
Applicant  		
<p>1. This International preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 6 sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the opinion</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Rule 86.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>		
Date of submission of the demand  <b>23.01.2004</b>	Date of completion of this report  <b>26.11.2004</b>	
Name and mailing address of the International preliminary examining authority:  <b>European Patent Office - P.B. 5818 Patentlaan 2  NL-2280 HV Rijswijk - Pays Bas  Tel. +31 70 340 - 2040 Tx: 31 651 epo nl  Fax: +31 70 340 - 3016</b>	Authorized Officer  <b>Puetz, C</b> Telephone No. +31 70 340-9759 	

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**International application No. **PCT/CA 03/00960****I. Basis of the report**

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-30 as originally filed

**Claims, Numbers**

1-43 received on 27.05.2004 with letter of 27.05.2004

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☒ the claims, Nos.: 44-69
- ☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

see separate sheet

6. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**International application No. **PCT/CA 03/00960****V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement****1. Statement**

Novelty (N)	Yes: Claims	
	No: Claims	1,33
Inventive step (IS)	Yes: Claims	
	No: Claims	1-43
Industrial applicability (IA)	Yes: Claims	1-43
	No: Claims	

**2. Citations and explanations****see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/CA 03/00960

**Re Item I:**

Some of the amendments filed with the letter of 27.5.2004 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT.

The amendments concerned are:

- claim 1: no basis for formula (c) (not disclosed at all)
- claim 14: the list of oxides given in brackets is not allowable. Compounds used in examples are only disclosed in combination with other compounds/ compositions used in the same example.
- claim 21: In the text passage given as basis for the claim (page 15, lines 8-13), the grain size of the particles is said to be less than 100nm. grain does not appear in the wording of claim 21.
- claim 22: Hydrogen storage device is not disclosed. In the definition of (b) no basis could be found for "or the compound thereof" (line 6).
- claims 27,29-32: Metals/compounds used in examples are only disclosed in combination with other compounds/ compositions used in the same example. The claims are not allowable.
- claim 36: Original claim 24 is given as basis for new claim 36. said claim is not concerned with step (b) of the method as claimed in new claim 33.
- claims 37,40,42: In the relevant text passages it is not stated that step (b) is specifically concerned.

**Re Item V:**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/CA 03/00960

## 1. Reference is made to the following documents:

- D1:** OELERICH W ET AL: "metal oxides as catalysts for improved hydrogen sorption in nanocrystalline Mg-based materials" JOURNAL OF ALLOYS AND COMPOUNDS, ELSEVIER SEQUOIA, LAUSANNE, CH, vol. 315, 2001, pages 237-242, XP002263119 ISSN: 0925-8388
- D2:** OELERICH W ET AL: "Comparison of the catalytic effects of V, V<sub>2</sub>O<sub>5</sub>, VN, and VC on the hydrogen sorption of nanocrystalline Mg" JOURNAL OF ALLOYS AND COMPOUNDS, ELSEVIER SEQUOIA, LAUSANNE, CH, vol. 322, no. 1-2, 28 June 2001 (2001-06-28), pages L5-L9, XP004243340 ISSN: 0925-8388
- D3:** WO 00/07930 A (UNIV HAWAII) 17 February 2000 (2000-02-17)
- D4:** US-A-4 507 263 (RON MOSHE) 26 March 1985 (1985-03-26)

2. At least claims 1 and 33 lack novelty over the teachings of documents **D1-D4**.

Document **D1** (see abstract) is concerned with the preparation of MgH<sub>2</sub>/(M<sub>x</sub>O<sub>y</sub>) composites using high energy ball milling. Hydrogen absorption and desorption kinetics of the nanocomposite materials are examined. The subject-matter of at least claims 1 and 33 of the present application is not novel.

Novelty objections also arise from **D2** (see abstract), **D3** (see page 6, lines 23 to page 7, line 17) and **D4** (see column 3, lines 29-48).

## 3. The subject-matter of at least claim 22 does not involve an inventive step in the sense of Article 33(3) PCT.

Document **D1** is regarded to represent the closest prior art. The subject-matter of claim 22 of the present application differs from **D1** in that a metallic hydrogen-absorbing or hydrogen-desorbing substance is additionally present. However, said additional features are conventional. It is already known that the composites from **D1** are capable to adsorb/desorb hydrogen. Therefore combination with further substances capable of absorbing/desorbing hydrogen would be within the ordinary skill of an expert in this art. An inventive step in the sense of Article 33(3) PCT cannot be acknowledged.

## 4. The dependent claims 2-21, 23-32, 34-43 are mere variations within the scope of claims 1, 22 or 33 to which they depend. They would be patentable only to the

**INTERNATIONAL PRELIMINARY** International application No. **PCT/CA 03/00960**  
**EXAMINATION REPORT - SEPARATE SHEET**

extent the subject-matter of claims 1,22,33 to which they refer would fulfill the requirements of Articles 33(2) and 33(3) PCT.

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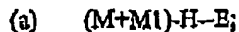
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What is claimed is:

1. A composition of matter having an atomic co-ordination characterized by one of the following structural formulae:



or



or



or



wherein:

M is a metal or metalloid, or an alloy thereof, or a compound thereof;

M1 is an optional metal different from M, or an alloy thereof, or a compound thereof;

H is hydrogen;

E is an electronegative element; and

hydrogen bonding exists between H and E in structural formulae (a) and (b), and between M and H in structural formulae (c) and (d).

2. The composition of matter defined in Claim 1, wherein M comprises a first combination of at least two of the metal or metalloid, or the alloy thereof, or the compound thereof.

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3. The composition of matter defined in Claim 2, wherein the first combination is homogeneous.
4. The composition of matter defined in Claim 2, wherein the first combination is inhomogeneous.
5. The composition of matter defined in Any one of Claims 1-4, wherein M1 comprises a second combination of at least two of the metal or metalloid, or the alloy thereof, or the compound thereof.
6. The composition of matter defined in Claim 5, wherein the second combination is homogeneous.
7. The composition of matter defined in Claim 5, wherein the second combination is inhomogeneous.
8. The composition of matter defined in Any one of Claims 1-7, wherein M is selected from the group consisting of Li, Na, K, Be, Mg, Ca, Y, Sc, Ti, Zr, Hf, V, Nb, Ta, Pt, Pd, Ru, Rh, Ge, Ga, In, La, Ce, Pr, Nd, Dy, Al, Si, and B.
9. The composition of matter defined in Any one of Claims 1-7, wherein M comprises Ti.
10. The composition of matter defined in Any one of Claims 1-7, wherein M comprises Zr.
11. The composition of matter defined in Any one of Claims 1-10, wherein M1 is selected from the group consisting of Cr, Mo, W, Mn, Fe, Co, Ir, Ni, Cu, Ag, Au, Zn, Sn, Pb, Sb, and Bi.
12. The composition of matter defined in Any one of Claims 1-10, wherein M1 comprises Cu.

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13. The composition of matter defined in Any one of Claims 1-12, wherein E is selected from the group comprising O, F, N, Cl, S, P, C, Te, I, Br and compounds thereof.

14. The composition of matter defined in Claim 13, wherein said compounds thereof are selected from the group comprising oxides (e.g., CuO, MgO, NiO, MnO, FeO), nitrides, halides, sulphides and tellurides, phosphides.

15. The composition of matter defined in Claim 13, wherein said compounds thereof are selected from CO and NO.

16. The composition of matter defined in Claim 13, wherein said compounds thereof comprise compounds coordinated with hydrogen atoms.

17. The composition of matter defined in Claim 16, wherein said compounds thereof coordinated with hydrogen atoms are selected from the group comprising water, hydroxides, phenols, alcohols, salts, acids, alkoxides, thiols, organic acids, salts of organic acids, acid amides, amines, acid halides, alkyl halides, sulphones, and organometallics.

18. The composition of matter defined in Any one of Claims 1-17, in particulate form.

19. The composition of matter defined in Claim 18, wherein said particulate form comprises particles having a size less than 100 microns.

20. The composition of matter defined in Claim 18, wherein said particulate form comprises 80% particles having a size less than 50 microns.

21. The composition of matter defined in Claim 18, wherein said particulate form comprises particles having a size less than 100 nm.

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22. A hydrogen storage device comprising:

a metallic substance selected from the group consisting of: (a) a hydride of a metal or metalloid, or an alloy thereof, or a compound thereof, or a homogeneous or inhomogeneous combination of at least two of the metal or metalloid, the alloy thereof, or the compound thereof, or (b) a metal or metalloid capable of absorbing hydrogen to form a hydride, or an alloy thereof, or a compound thereof, or an homogeneous or inhomogeneous combination of at least two of the metal or metalloid, the alloy thereof, or the compound thereof; and

the composition of matter defined in any one of Claims 1-21.

23. The hydrogen storage device defined in Claim 22, wherein the metallic substance comprises a metal hydride.

24. The hydrogen storage device defined in Claim 23, wherein the metal hydride is selected from the group comprising vanadium hydrides, titanium hydrides and hydrides of vanadium-titanium alloys.

25. The hydrogen storage device defined in Claim 23, wherein the metal hydride comprises magnesium hydride.

26. The hydrogen storage device defined in Claim 23, wherein the metal hydride is selected from the group comprising sodium hydride and lithium hydride.

27. The hydrogen storage device defined in Claim 23, wherein the metal hydride comprises is selected from the group comprising sodium tetrahydridoaluminate and lithium tetrahydridoaluminate.

28. The hydrogen storage device defined in Claim 22, wherein the metallic substance comprises a metal capable of absorbing hydrogen to form a hydride.

29. The hydrogen storage device defined in Claim 28, wherein the metal capable of absorbing hydrogen to form a hydride comprises Ti.

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30. The hydrogen storage device defined in Claim 28, wherein the metal capable of absorbing hydrogen to form a hydride comprises Zr.
31. The hydrogen storage device defined in Claim 28, wherein the metal capable of absorbing hydrogen to form a hydride comprises Nb.
32. The hydrogen storage device defined in Claim 28, wherein the metal capable of absorbing hydrogen to form a hydride comprises Mg.
33. A method for preparing the composition of matter defined in any one of Claims 1-21 comprising steps of:
- (a) combining (i) a metallic substance selected from the group consisting of a hydrogenated, metal or metalloid, or an alloy thereof, or a compound thereof, or an homogeneous or inhomogeneous combination of at least two of the hydrogenated, metal or metalloid, or the alloy thereof, or the compound thereof, with (ii) a source of an electronegative element, to form a first intermediate; and
  - (b) milling the first intermediate to effect reaction between the metallic substance and the electronegative element.
34. The method defined in Claim 33, wherein Step (b) is carried out in a substantially inert environment.
35. The method defined in any one of Claims 33-34, wherein Step (b) is carried out in a gaseous environment having an insufficient concentration of a reducing agent to effect deleterious reduction of the intermediate product.
36. The method defined in any one of Claims 33-35, wherein Step (b) is carried out in a high energy ball mill.
37. The method defined in any one of Claims 33-36, wherein Step (b) is carried out in the presence of a liquid.

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38. The method defined in Claim 37, wherein the liquid is selected from water, alcohol and mixtures thereof.
39. The method defined in any one of Claims 37-38, wherein the molar ratio of the liquid to the metallic substance is less than 1:1.
40. The method defined in any one of Claims 33-36, wherein Step (b) comprises milling the metallic substance with a gaseous reagent.
41. The method defined in Claim 40, wherein the gaseous reagent is selected from the group comprising hydrogen, oxygen, chlorine, fluorine and nitrogen.
42. The method defined in any one of Claims 33-36, wherein Step (b) comprises milling the metallic substance with a solid reagent.
43. The method defined in Claim 42, wherein the solid reagent is selected from the group comprising a solid hydrocarbon, an oxide, a chloride, a fluoride, a sulfide, a carbide, a telluride, an iodide and an alkoxide.

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